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Terrestrial and Semi-Aquatic Vertebrates in Diets of Largemouth Bass in Central Nebraska

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NOTES

TERRESTRIAL AND SEMI-AQUATIC VERTEBRATES IN DIETS OF LARGEMOUTH BASS IN CENTRAL NEBRASKA—Largemouth bass (*Micropterus salmoides)* are opportunistic predators often feeding in littoral areas during crepuscular periods (Snow 1971). Adult largemouth bass primarily are piscivorous, whereas juveniles generally consume zooplankton, insects, and small fish (Zweiacker and Summerfelt 1974, Carlander 1977, Post 2003). Age-0 largemouth bass generally consume zooplankton and macroinvertebrates (Keast and Webb 1966, Keast 1985, Phillips et al. 1995, Post 2003) and shift to piscivory at 50-70 mm in length (Phillips et al. 1995, Olson 1996, Post 2003). Few studies have documented detailed accounts of other vertebrates besides fish in diets of largemouth bass, which include amphibians (Hodgson and Kitchell 1987, Hodgson and Hansen 2005), reptiles (Hodgson and Kitchell 1987, Britson and Gutzke 1993), birds (Hodgson and Hansen 2005), and mammals (Clady 1974, Hodgson 1986, Hodgson and Kitchell 1987, Hodgson and Kinsella 1995). Depending on location and season, non-fish vertebrates can contribute substantially to diets of largemouth bass. For example, small mammals composed over 50% of the volume of bass diets in May-June in Cub Lake, Michigan (Clady 1974). To our knowledge, no study in the Great Plains has documented terrestrial or semi-aquatic vertebrates in largemouth bass diets to date. Herein we report on the presence of terrestrial and semi-aquatic vertebrates in largemouth bass diets in borrow-pit lakes in central Nebraska, representing several new species of prey items for largemouth bass.

We sampled eight borrow pits in Lincoln and Buffalo counties, Nebraska, for largemouth bass in July–October 2010 and May–June 2011, to survey all months with open water. Borrow pits were created in the 1960s when sand was excavated for use in construction of Interstate-80 (McCarraher et al. 1974). Many of these groundwater-filled lakes have been stocked with fish species for recreational purposes by the Nebraska Game and Parks Commission (McCarraher et al. 1974). Borrow pits consist of sandy bottoms, clear water, varying depths, and differing percentages of aquatic vegetative coverage. Fish communities in each lake generally consisted of largemouth bass, bluegill (*Lepomis macrochirus*), and channel catfish (*Ictalurus puctatus*). Additional fish species encountered with less frequency and varying densities included black crappie (*Pomoxis nigromaculatus*), rock bass (*Ambloplites rupestris*), yellow perch (*Perca flavescens*), redear sunfish (*L. microlophus*), northern pike (*Esox luscious*), flathead catfish (*Pylodictis olivaris*), walleye (*Sander vitreus*), green sunfish (*L. cyanellus*), common carp (*Cyprinus carpio*), and gizzard shad (*Dorosoma cepedianum*).

Aquatic vegetation was sampled during September of 2010 to obtain percent cover by family of submergent and emergent macrophytes. We assessed submergent vegetation by random point sampling following the methods of Stukel (2003). We created random points in ArcView 3.2 (ESRI, Inc., Redlands, CA, USA) and determined sample size by lake surface area with a minimum number of 15 points for each lake. We assessed emergent vegetation using the latest aerial images from the United States Geological Service (USGS) and ArcView by dividing the area containing vegetation by the total surface area of the lake. Additionally, we took Secchi disk readings to assess water clarity (Table 1).

Table 1. Surface area (ha), maximum depth (m), Secchi depth (m), and percent coverage (%) of emergent and submergent vegetation in borrow pit lakes sampled in central Nebraska, 2010–2011.

				Vegetation Coverage	
Lake	Surface Area	Max Depth	Secchi Depth	Emergent	Submergent
Ft. Kearny #5	1.1	6.5	1.2	0.0	33.3
Windmill #2	1.2	5.5	1.2	0.0	46.7
Kea West	3.0	4.5	1.3	17.0	35.0
Crystal	3.0	3.5	2.2	2.8	20.0
West Gothenburg	4.7	5.5	2.4	15.6	20.0
Bufflehead	5.1	3.0	>3.0	0.0	92.0
Fremont Slough	9.9	5.0	0.9	2.9	12.0
Pawnee Slough	12.2	2.5	0.9	24.7	96.0

We captured largemouth bass at night via boat electrofishing with pulsed DC to increase catch per unit effort (Paragamian 1989). We sampled once monthly May–August, and intensively (n = 4–9 sampling events per pit) during September and October while studying the impact of largemouth bass predation on stocked yellow perch survival in borrow pits. In each borrow pit we sampled until either the entire shoreline was sampled or 50 largemouth bass were captured. We collected prey of largemouth bass from their stomachs using pulsed gastric lavage (Seaburg 1957) and recorded total lengths (mm) and weights (g) of all largemouth bass. We preserved all stomach contents in 95% alcohol and identified vertebrate prey items to the lowest identifiable taxa. Representative individuals of terrestrial and semi-aquatic vertebrates were deposited in natural history collections at the University of Nebraska at Kearney. Research was approved by the Institutional Animal Care and Use Committee at the University of Nebraska at Kearney (Approval number 061010).

We observed that terrestrial and semi-aquatic vertebrates composed less than 1% volumetrically and numerically of all prey items in the diets of largemouth bass for both years. In all, we examined 3,657 stomach samples of largemouth bass and observed 20 terrestrial and 22 semi-aquatic vertebrates, including 6 species of mammals, 2 species of reptiles, 2 taxa of birds, and at least 1 species of amphibian (Table 2). Largemouth bass that consumed vertebrates were mostly adults (≥age-3), with exception of one age-1 (TL = 173 mm) and one age-2 (TL = 222 mm) individual. Almost all vertebrates in stomachs were singletons; however, one largemouth bass contained two passerine birds and another contained two unidentifiable Anurans.

Our study documents mammalian species formerly not known as prey items for largemouth bass. To our knowledge, only six species of small mammals are known as prey items for largemouth bass in the United States. The meadow vole (*Microtus pennsylvanicus*), northern short-tailed shrew (*Blarina brevicauda*), woodland jumping mouse (*Napeozapus insignis*), and American water shrew (*Sorex palustris*) were documented in largemouth bass stomachs in the Upper Peninsula of Michigan (Clady 1974, Hodgson 1986). Hodgson and Kinsella (1995) observed two additional species of mammals in bass diets in kettle lakes in the Upper Peninsula of Michigan, including the eastern chipmunk (*Tamias striatus*) and star-nosed mole (*Condylura cristata*). The western harvest mouse (*Reithrodontomys megalotis*), least shrew (*Cryptotis parva*), masked shrew (*S. cinereus*), and prairie vole (*M. ochrogaster*) have not been previously reported as prey items for largemouth bass.

Reptiles also are consumed by largemouth bass, including the painted turtle (*Chrysemys picta*; Hodgson and Hanson 2005); however, Britson and Gutzke (1993) suggested that largemouth bass have a learned avoidance for consuming hatchling painted turtles. We documented a single hatchling painted turtle (weight = 8.07 g, carapace length = 35 mm) consumed by a largemouth bass in central Nebraska (Table 2). The plains garter snake (*Thamnophis radix*) also appears to be the first reported occurrence in the diet of largemouth bass; however, Hodgson and Hansen (2005) documented a northern ribbon snake (*T. sauritus*) consumed in kettle lakes in the Upper Peninsula of Michigan.

Studies indicate that largemouth bass also prey upon frogs including the northern leopard frog (*Lithobates pipiens*), green frog (*L. clamitans*), and spring peeper (*Hyla crucifer*; Hodgson and Hansen 2005). Our documentation of adult plains leopard frogs (*L. blairi*) appears to be the first published record in the diet of largemouth bass. Birds also are prey items of largemouth bass (Hodgson and Hansen 2005). Hodgson and Hansen (2005) observed a red-winged blackbird (*Agelaius phoeniceus*) and a warbler species (*Dendroica* spp.) consumed by largemouth bass. Birds appear least frequently of all non-fish, vertebrates prey items consumed by largemouth bass.

This is the first study to document terrestrial and semi-aquatic vertebrates in the diets of largemouth bass in the Great Plains. Terrestrial and semi-aquatic vertebrates usually do not constitute a large portion of largemouth bass diets, and this study supports what others have reported in other regions of the United States. Surface disturbances, such as swimming, likely contribute to vertebrates being predated by largemouth bass. Our study demonstrates that largemouth bass will prey upon many terrestrial and semi-aquatic vertebrates if opportunities are presented and prey items are of appropriate size.

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Table 2. Species, date, and location of terrestrial and semi-aquatic vertebrates observed in diets of largemouth bass (*Micropterus salmoides*; LMB) in central Nebraska, 2010–2011. We also reported length (mm) and weight (g) of each LMB sampled.

			LMB	
Species	Date	Lake[a]	Length	Weight
Amphibians				
Anura spp.	31 Aug 2010	Windmill #2	285	355
Lithobates spp.	3 Sep 2010	Windmill #2	260	258
Lithobates spp.	3 Sep 2010	Kea West	222	146
Anura spp.	3 Sep 2010	Ft. Kearny #5	264	239
Anura spp.	6 Sep 2010	Kea West	395	953
Lithobates spp.	15 Sep 2010	Ft. Kearny #5	274	260
Lithobates blairi	20 Sep 2010	Ft. Kearny #5	312	380
1 *Lithobates* spp. + 1 Anura spp.	20 Sep 2010	Ft. Kearny #5	475	1740
Lithobates spp.	20 Sep 2010	Windmill #2	285	340
Lithobates spp.	28 Sep 2010	Ft. Kearny #5	294	277
Lithobates blairi	28 Sep 2010	Ft. Kearny #5	251	182
Lithobates spp.	28 Sep 2010	Kea West	418	1040
Lithobates spp.	5 Oct 2010	Windmill #2	294	388
Anura spp.	5 Oct 2010	Windmill #2	306	424
Lithobates spp.	5 Oct 2010	Ft. Kearny #5	173	60
Anura spp.	5 Oct 2010	Ft. Kearny #5	287	317
Anura spp.	12 Oct 2010	Ft. Kearny #5	299	375
Anura spp.	12 Oct 2010	Windmill #2	364	641
Lithobates spp.	18 Oct 2010	Kea West	366	768
Anura spp.	18 Oct 2010	Windmill #2	286	360
Small Mammals				
Microtus pennsylvanicus	1 Sep 2010	West Gothenburg	284	300
Blarina brevicauda	7 Sep 2010	West Gothenburg	281	197
Microtus pennsylvanicus	9 Sep 2010	Pawnee Slough	335	488
Reithrodontomys megalotis	9 Sep 2010	Pawnee Slough	285	322
Microtus spp.	9 Sep 2010	Pawnee Slough	377	758
Cryptotis parva	23 Sep 2010	West Gothenburg	302	330
Cryptotis parva	27 Sep 2010	West Gothenburg	290	320
Sorex cinereus	4 Oct 2010	West Gothenburg	282	300
Cryptotis parva	4 Oct 2010	West Gothenburg	291	333
Microtus ochrogaster	26 May 2011	Crystal	320	446
Microtus ochrogaster	26 May 2011	Crystal	288	284
Microtus ochrogaster	26 May 2011	Crystal	315	424
Microtus pennsylvanicus	22 Jun 2011	Crystal	291	316
Reptiles				
Thamnophis radix	12 Oct 2010	Windmill #2	279	300
Thamnophis radix	15 Jun 2011	Pawnee Slough	406	902
Thamnophis radix	15 Jun 2011	Pawnee Slough	291	352
Chrysemys picta	22 Jun 2011	Fremont Slough	369	718
Birds				
2 Passerine spp.	12 Jul 2010	Pawnee Slough	234	186
Passerine spp.	7 Sep 2010	Fremont Slough	404	1045
Tyrannidae spp.	15 Sep 2010	Ft. Kearny #5	290	299

[a] Windmill Lake #2 (40.7059° N, 98.8422° W), Kea West (40.6715° N, 99.1069° W), and Ft. Kearny Lake #5 (40.6537° N, 98.9951° W) were in Buffalo County. West Gothenburg (40.9864° N, 100.3029° W), Pawnee Slough (41.0815° N, 100.54° W), Crystal Lake (41.0834° N, 100.618° W), and Fremont Slough (41.0972° N, 100.6670° W) were in Lincoln County.

LITERATURE CITED

Britson, C. A., and W. H. N. Gutzke. 1993. Antipredator mechanisms of hatchling freshwater turtles. Copeia 1993:435–440.

Carlander, K. D. 1977. Handbook of freshwater fishery biology, Volume 2. Iowa State University, Ames, USA.

Clady, M. D. 1974. Food habits of yellow perch, smallmouth bass, and largemouth bass in two unproductive lakes in northern Michigan. American Midland Naturalist 91:453–459.

Hodgson, J. R. 1986. The occurrence of small mammals in the diets of largemouth bass (*Micropterus salmoides*). The Jack-Pine Warbler 64:39–40.

Hodgson, J. R., and E. M. Hansen. 2005. Terrestrial prey items in the diet of largemouth bass, *Micropterus salmoides*, in a small north temperate lake. Journal of Freshwater Ecology 20:793–794.

Hodgson, J. R., and M. J. Kinsella. 1995. Small mammals in the diet of largemouth bass, revisited. Journal of Freshwater Ecology 10:433–435.

Hodgson, J. R., and J. F. Kitchell. 1987. Opportunistic foraging by largemouth bass (*Micropterus salmoides*). American Midland Naturalist 118:323–336.

Keast, A. 1985. The piscivore feeding guild of fishes in small freshwater ecosystems. Environmental Biology of Fishes 12:119–129.

Keast, A., and D. Webb. 1966. Mouth and body form relative to feeding ecology in the fish fauna of a small lake, Lake Opinicon, Ontario. Journal of the Fisheries Research Board of Canada 23:1845–1874.

McCarraher, D. B., R. A. McDonald, and G. L. Adrian. 1974. Hydrobiological characteristics of Interstate-80 highway lakes in Nebraska. Transactions of the Kansas Academy of Science 77:93–102.

Olson, M. H. 1996. Ontogenetic niche shifts in largemouth bass: variability and consequences for first-year growth. Ecology 77:179–190.

Paragamian, V. L. 1989. A comparison of day and night electrofishing: size structure and catch per unit effort for smallmouth bass. North American Journal of Fisheries Management 9:500–503.

Phillips, J. M., J. R. Jackson, and R. L. Noble. 1995. Hatching date influence on age-specific diet and growth of age-0 largemouth bass. Transactions of the American Fisheries Society 124:370–379.

Post, D. M. 2003. Individual variation in the timing of ontogenetic niche shifts in largemouth bass. Ecology 84:1298–1310.

Seaburg, K. G. 1957. A stomach sampler for live fish. The Progressive Fish Culturist 19:137–139.

Snow, H. E. 1971. Harvest and feeding habits of largemouth bass in Murphy Flowage, Wisconsin. Wisconsin Department of Natural Resources Technical Bulletin 50. Madison, USA.

Stukel, S. M. 2003. Assessing the sustainability of fish communities in glacial lakes: habitat inventories and relationships between lake attributes and fish communities. Thesis, South Dakota State University, Brookings, USA.

Zweiacker, P. L., and R. C. Summerfelt. 1974. Seasonal variation in food and diet periodicity in feeding of northern largemouth bass, *Micropterus salmoides salmoides* (Lacepede), in an Oklahoma Reservoir. Proceedings of the Southeastern Association of Fish and Wildlife Agencies 27:579–591.

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